

UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 7.

[In order to render the results of investigations and experiments conducted by the Agricultural Department of the University of California more quickly and more generally available than has heretofore been done through the annual or biennial reports, it is proposed to embody hereafter, in the form of "Bulletins," to be issued as often as may seem desirable, reports of results, as well as such other discussions, information or answers to questions as may be of general interest. It is intended to make these bulletins, as a rule, short enough for insertion in the daily or weekly papers of the State, and proof-slips of the same will be regularly mailed to papers applying therefor. The substance of these bulletins will ultimately be embodied in a more complete and connected form, in the annual reports of the College of Agriculture.]

Examination of Irrigation Waters

1. From an artesian well on the property of Mr. Timothy Paige, Tulare county.

The large supply of artesian water now ascertained to exist beneath a large portion of Tulare county not otherwise within easy reach of irrigation water, renders the ascertainment of its quality of no mean importance to that fertile region.

The sample examined was supplied by Mr. Cutler Paige (class of 1882), who states that the well from which it was taken is of large bore, and at present yields a supply of about 800,000 gallons per 24 hours. The water is clear and possesses no obvious peculiarity of taste. It, however, shows a slightly alkaline reaction on delicate test paper. On evaporation it leaves a whitish residue amounting to 11.8 grains per gallon, of which water re-dissolves only a little over 10 grains, leaving about 2 grains of insoluble residue. These portions are constituted as follows:

SOLUBLE PART.		
	Grains per gallon.	Per cent of residue.
Sulphate of potash.....	.745	6.31
Carbonate of potassium.....	.380	3.22
Carbonate of soda.....	8.559	72.54
Chloride of sodium.....	.405	3.43
Total soluble salts.....	10.079	85.50
INSOLUBLE PART.		
Carbonate of lime.....	.457	3.88
Carbonate of magnesia.....	.708	5.97
Silica.....	.803	6.85
Total insoluble matter.....	1.973	16.70

It will be seen that while the total residue contained in this water is not unusually large, over two-thirds—eight and a half grains—consist of carbonate of soda or "black alkali." At the same time, nearly one grain per gallon consists of salts of potassium, of high manurial value; so that irrigation to the extent of ten inches over all would supply about 53 pounds of these substances per acre.

On land entirely free from alkali this water might be used for irrigation for a number of years without injurious effects, although with surface irrigation the accumulation of carbonate of soda would after a while become detrimental

to plant growth. On land already more or less impregnated, the addition made by the annual irrigation would soon become perceptible, unless counteracted by the use of plaster for the neutralization of the carbonate of soda.

It is to be hoped, however, that the water of this well is exceptional among those in the Tulare artesian belt, and it is quite certain that the water of others differs from the one here reported. That from one of the first wells bored by Mr. Paige, and analyzed by his son, showed only a trifle over nine grains of solid matter per gallon, and of this only a small proportion—a little over one grain—was carbonate of soda. It is therefore probable that this purer water represents the normal composition of the artesian supply, and that the increased amount of the injurious substance found in the present case is due to an influx of shallower streams connected with the alkali-bearing beds underlying Tulare lake, that should have been tubed out in boring. This is a point that should receive the most earnest attention of those now boring or intending to sink artesian wells in that region, whose natural supply of alkali in the soil will not bear much increase.

In connection with the above, the following data from the examination of a soil taken from near the shore of Tulare lake by Mr. Cutler Paige, are of some interest. This soil differs somewhat in its nature from that previously examined (see Report for 1879, p. 27, and for 1880, p. 22), which was taken by Mr. E. R. Thomason from the southeast end of Tulare lake. The present soil, taken much farther north, shows much more coarse sand and shell fragments, as well as true clay; while the former was more of a silty character, and boggy when wet. Here also, however, the soil is considerably impregnated with alkali, and from want of aeration contains injurious "ferrous" salts. The bluish tint due to the latter changes to a yellowish one when the soil remains exposed to the air, whereby the injurious iron compounds are changed to an innocuous state.

The soil on leaching yielded .83 per cent of soluble matter, of the following composition:

Carbonate of soda.....	13.2
Common and Glauber's salts.....	31.3
Carb. lime, magnesia, silica.....	43.0
Vegetable matter, etc.....	7.5
	100.0

It thus appears that of the .83 per cent, one-half is unobjectionable, the rest a mixture of alkaline salts, of which nearly two-fifths is carbonate of soda.

A farther determination showed that this soil contains .223 per cent of phosphoric acid; somewhat less than in the soil previously reported on, but still an ample supply. There can be no doubt that with proper measures for reclamation, these soils of the Tulare shores should be profusely fertile. But they will not bear any increase of their alkali by the use of alkaline irrigation waters.

2. *Irrigation water from the Sierra Madre*, above San Gabriel, sent by Mr. H. J. Woollacott, of Los Angeles, desiring to know how it compares with the water from the San Fernando tunnel, heretofore analyzed and reported upon. He also states that it has been found unsuitable for drinking purposes.

The water is clear and shows no obvious taste. On evaporation it leaves residue amounting to 18.9 grains per gallon. Of this, only about one-half is again soluble in water. It consists of:

Sulphate and chloride of sodium (or Glauber's and common salt).....	9.1 grains.
Carbonate of soda.....	.4 grains.
Carbonate of lime and magnesia, and silica..	9.4 grains.
Total.....	18.9 grains.

This analysis shows the water to be radically different from that of the San Fernando tunnel; and it is not obvious why it should be unsuitable for drinking purposes, as its solid matter is almost identical in amount and kind with that of the Los Angeles river, as taken from the city hydrants (see Report for 1880, p. 22), which, it is true, is close to the limits usually assigned to the admissible mineral contents of potable waters. But neither contain any appreciable amount of the objectionable earthy salts—sulphates of lime and magnesia—which render the San Fernando water not only injurious for drinking purposes, but even of doubtful applicability for irrigation.

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